June 23, 1964 T. R. VESSELS 3,138,335

APPARATUS FOR APPLYING CONCRETE TO SURFACES

Filed Feb. 23, 1961 2 Sheets-Sheet 1

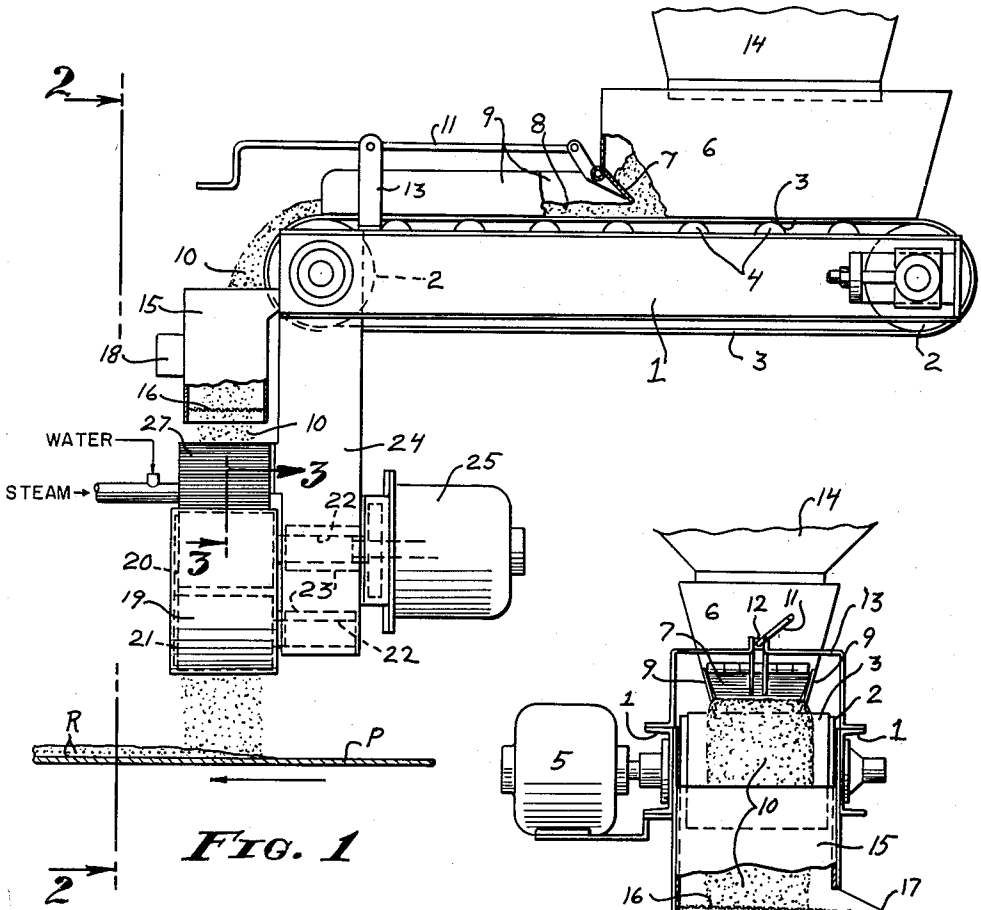

FIG. 1

FIG. 2

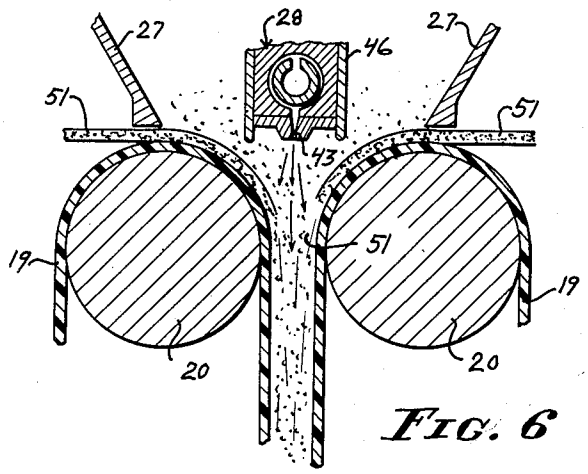

FIG. 6

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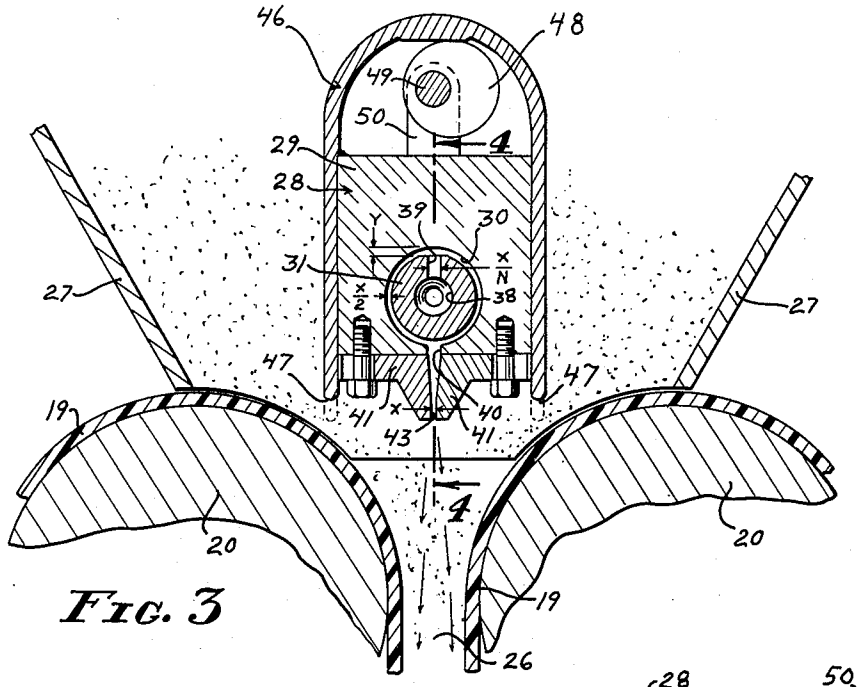

FIG. 3

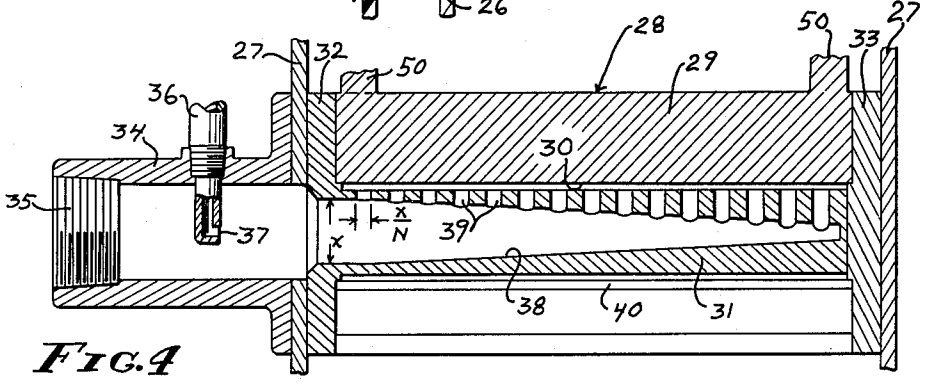

FIG. 4

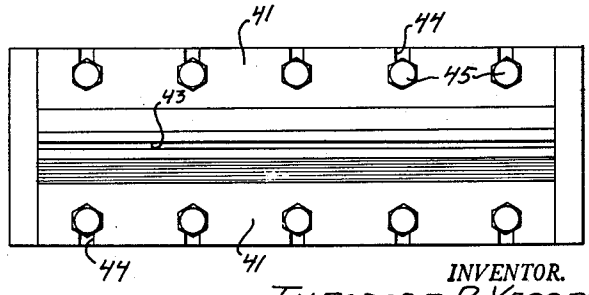

FIG. 5

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APPARATUS FOR APPLYING CONCRETE TO SURFACES

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13 Claims. (Cl. 241—39)

This invention relates to apparatus for applying concrete to surfaces, and included in the objects of this invention are:

First, to provide an apparatus which, while capable of applying concrete to a variety of surfaces, is particularly adapted to apply concrete to the outer surface of metal pipe.

Second, to provide an apparatus for applying concrete which is capable of effecting a uniform and intimate mixture of large quantities of cement, sand, and water, and propelling the mixture at high velocity against a surface to be coated in such a manner that the mixture adheres to the surface with a minimum of rebound or loss.

Third, to provide an apparatus for applying concrete wherein a uniform blanket of a sand and cement mixture is metered from a hopper at a uniform rate onto a conveyor belt, then permitted to fall, and while falling to be entrained in a high velocity steam-water jet; the resulting mixture then being further guided and directed between a pair of propelling belts for discharge against the surface to be coated.

Fourth, to provide, in an apparatus for applying concrete, a novelly constructed nozzle structure in which water and steam is mixed and uniformly discharged through a slit of substantial width to produce a ribbon-like jet in which the sand-cement mixture is entrained.

Fifth, to provide an apparatus which, although primarily adapted to handle sand-cement and steam-water mixtures, may be utilized to handle a wide range of other mobile solid mixtures, and other gas-liquid mixtures.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawings in which:

FIGURE 1 is a substantially diagrammatical side view of the apparatus with portions broken away and in section;

FIGURE 2 is an end view thereof taken substantially along the line 2—2 of FIGURE 1;

FIGURE 3 is an enlarged, fragmentary, sectional view through 3—3 of FIGURE 1 showing the relationship of the jetting structure and propelling belts;

FIGURE 4 is a longitudinal sectional view of the jetting structure taken through 4—4 of FIGURE 3;

FIGURE 5 is a bottom view of the jetting structure with the intake fitting omitted;

FIGURE 6 is a diagrammatical view corresponding to FIGURE 3 showing a modification of the apparatus whereby fibrous reinforcing material is introduced into the mixture of solid and liquid ingredients as they enter the jetting belts.

The apparatus for applying concrete to surfaces includes a pair of side frames 1 between the extremities of which are journaled end rollers 2 over which is wrapped a conveyor belt 3 having a substantially horizontal upper reach. Intermediate rollers 4 may support the upper reach of the conveyor belt between the end rollers 2. A motor drive 5 is connected with one of the end rollers, preferably at the discharge end of the conveyor belt.

Suitably supported above the conveyor belt 3 is a metering hopper 6 occupying the end portion of the conveyor belt offset from its discharge end. The metering hopper is provided with a metering gate 7 which may

be pivoted relative to the upper reach of the conveyor belt so that the conveyor belt withdraws from the metering hopper a blanket 8 of mobile material, as indicated in FIGURE 1. Side fences 9, extending from the metering gate 7 toward the discharge end of the conveyor, confine the blanket 8 of mobile material. The mobile material on discharge from the conveyor belt 3 forms a freely falling stream 10.

The metering gate 7 may be operated by an adjustment rod 11 having a suitable hand crank at one end and screw-threaded in a nut 12 held between brackets 13 extending upwardly from the side frames 1.

The mobile material may be supplied to the metering hopper 6 through a conventional storage hopper 14.

The freely following stream 10 of mobile material enters a vertical guide chute 15, near the lower end of which is a screen 16. The screen slopes laterally, and its lower end communicates with a laterally directed discharge chute 17.

The mesh of the screen 16 is relatively coarse as compared to the particle size of the mobile material, so that the screen offers little impedance to the falling material. However, should large objects or tramp material be present, it is caught on the screen and deflected laterally. A conventional vibrator 18 is attached to the discharge chute 17 so that the screen 16 vibrates not only to ensure passage of the mobile material but to facilitate the breaking up of any loosely agglomerated portions of the material.

Disposed below the vertical guide chute 15 is a pair of propelling belts 19 which fit over a pair of upper rollers 20 and a pair of lower rollers 21. The rollers are disposed in vertical relationship and so positioned as to place vertically disposed reaches of the belt in confronting but spaced relation.

The rollers 20 and 21 are mounted on shafts 22 journaled in bearings 23, which may be supported by vertical frames 24 extending downward from the side frames 1. A motor drive 25 including gear means connecting the shafts 22 of the upper rollers 20 drive the propelling belts 19 in a direction to cause their confronting reaches to move downward. These reaches or walls thus form a propelling passageway 26 therebetween.

Mounted immediately above the propelling belts 19 is a funnel structure 27 having end walls which converge downward to the upper portions of the propelling belts 19. These portions of the belts which move inwardly toward each other form the underside of the funnel structure 27. The upper end of the funnel structure 27 is dimensioned to receive the stream 10 of the mobile material as it passes through the screen 16.

Extending transversely across the funnel structure 27 in vertical alignment with the propelling passageway 26 is a jetting structure 28. The jetting structure includes a jacket or body member 29 having a cylindrical bore 30 therethrough in which is mounted an externally cylindrical manifold 31. One end of the manifold is provided with a flange 32 which is secured to one end of the body member 29. The opposite end of the body member receives an end plate 33 which closes the cylindrical bore 30.

Secured to the flanged end 32 is a mating flanged end of an inlet fitting 34 having a bore 35 disposed in coaxial relation with the bore 30 of the body member 29. The bore 35 is adapted to be connected to a supply line for steam or gas, as will be brought out hereinafter. Intersecting the inlet fitting 34 is a liquid inlet tube 36 which projects into the bore 35 and is provided with an orifice 37 which is directed axially toward the manifold 31.

The manifold 31 is provided with a tapered bore 38 which diminishes in cross section from the flanged end 32 toward the extended end of the manifold. The tapered bore 38 is intersected by a row of upwardly directed or

laterally extending ports 39. The manifold 31 is smaller in diameter than the cylindrical bore 30 so as to define with the walls of the cylindrical bore 30 complementary semicylindrical passageways which join a common downwardly directed outlet 40 at the underside of the body member 29. The outlet 40 is in the form of a slit axially coextensive with the cylindrical bore 30.

Secured to the underside of the body member 29 is a pair of nozzle plates 41 having downwardly directed confronting flanges 42 which define therebetween a downwardly directed nozzle slit 43 communicating with the outlet 40. The two nozzle plates are provided with a series of laterally directed slots 44 which receive bolts 45. The bolts screw upwardly into the body member 29, and the slots 44 permit lateral adjustment of the nozzle slit 43.

The inlet or larger end of the tapered bore 38 has an area X, while each of the ports 39 has an area X/N where N represents the number of ports, that is, the sum of the areas of the ports equals the inlet area of the tapered bore 38. In addition, the upper side of the manifold 31 is flattened slightly so that the vertical distance between the outlet ends of the ports 39 and the upper wall of the bore 30 define a cylinder above each port having a vertical dimension Y such that the area of each cylinder equals the area of the corresponding port. The areas of the two semicircular passageways leading from the ports 39 to the outlet 40 are preferably a half X. Still further, the nozzle slit 43 is adjusted so that its area is equal to X. By adhering substantially to the proportions indicated above, the rate of flow is uniform throughout the major dimension of the nozzle slit 43. This is highly desirable in the operation of the apparatus as will be brought out hereinafter.

Fitted over the jetting structure 28 is an inverted U-shaped shield 46, the lower ends of which form gate members 47 which cooperate with the propelling belts 19 to form means for control of the flow of the mobile material into the propelling passageway 26. The shield 46 is vertically adjustable by means of cams 48 mounted on a shaft 49 journaled in brackets 50 extending upwardly from the body member 29 of the jetting structure 28.

The apparatus is primarily intended for applying concrete to surfaces, and in such use it is applied as follows:

A mobile dry mixture of sand and cement is fed from the storage hopper 14 into the metering hopper 6. As the conveyor belt 3 moves under the metering hopper 6, the metering gate 7 causes a uniform blanket 8 of the dry mixture to be carried along the conveyor belt 3 and discharged therefrom into the guide chute 15. The dry mixture passes readily through the screen 16 whereas any rocks, tramp steel, or large objects are deflected by the screen 16 into the lateral discharge chute 17.

The falling dry mixture enters the funnel structure 27 and passes around opposite sides of the jetting structure 28 onto the portions of the propelling belts 19, which move toward each other and into the confronting reaches which form the side walls of the propelling passageway 26. The belts rotate at relatively high speeds so that the dry mixture or ingredients are propelled downward at high velocity. Simultaneously, steam is introduced through the bore 35 of the inlet fitting 34 and water is introduced through the orifice 37. The steam-water mixture flows through the tapered bore 38, upwardly through the ports 39, then around the manifold 31, through the outlet 40, and nozzle slit 43.

The discharging mixture of steam and water immediately mixes with the dry ingredients. In effect two streams of dry ingredients are thrown towards each other by the upper portions of these belts, as these belts move toward each other, in the very region into which the steam-water mixture is discharged from the nozzle slit 43. As a consequence, a rapid and intimate mixture of all of the ingredients occurs, and continues to occur as the liquid, as well as the dry ingredients, move downward through the propelling passageway 26.

The major dimension of the nozzle slit 43 is substantially equal to the width of the propelling belts 19, or are at least equal to the width of that portion of these belts occupied by the streams of dry ingredients. As a consequence, a relatively wide stream may be directed against the underlying surface to be coated with the assurance that all portions of the stream contain uniformly mixed ingredients.

In the application of concrete to surfaces such as metal pipe P, as indicated in FIGURES 1 and 2, the concrete may be applied with extreme rapidity; that is, the pipe may be rotated as well as advanced rapidly so as to coat a length of pipe in a minimum of time. By reason of the fact that the liquid ingredients are uniformly distributed throughout the major width of the resulting stream, a maximum percentage of the material is caused to adhere. Stated otherwise, if the margins of the resulting stream are deficient in the liquid ingredients, an excessive amount of the dry ingredients merely strike the surface and bounce off, and are therefore wasted. It is for this reason that it is highly important to effect a uniform distribution of the liquid ingredients.

While the apparatus is directed particularly to the coating of surfaces with concrete, it should be observed that the apparatus may be utilized wherever it is desirable to bring dry, mobile materials and liquid mobile materials together and effect their intimate mixture before application to a surface.

For example, the dry mobile material may comprise various fibers such as glass or asbestos, and may comprise granular materials mixed with various plastics in a powdered or granular condition for coating the fibrous or granular materials. Similarly, air may be utilized as the motivating gas in place of steam, and various solvents or polymerizing agents may be utilized in place of or mixed with the water.

By reason of the fact that a relatively wide band of material may be discharged from the apparatus against the surface to be coated, a relatively thick coating may be built up with a single pass of the apparatus. This facilitates the wrapping of wire or reinforcing R, as indicated in FIGURES 1 and 2.

Reference is directed to FIGURE 6. The structure shown in FIGURE 6 is similar to the previously described structure except that the funnel structure 27 is raised so that webs 51 of coherent interlocked or interwoven fibrous material may be drawn inwardly across the propelling belts. The fibrous material may be woven material, felted material, or rope-like roving of various fibers, depending upon its purpose. For example, but not by way of limitation, the fibers may be asbestos, glass, hemp, or various plastic or metal fibers, with or without binders or coatings. The fibrous material is initially prepared so as to withstand moderate tension as it is drawn over the upper ends of the propelling belts, but is capable of shredding when subjected to the forces produced in the propelling passage.

The fibrous material first passes under the solid ingredients and moves therewith under the jet from the nozzle structure, and is immediately shredded and intimately mixed with the other ingredients.

The fibrous material may serve to reinforce the resulting material, reduce its density, or otherwise modify its properties.

While particular embodiments of this invention have been shown and described, it is not intended to limit the same to the exact details of the constructions set forth, and it embraces such changes, modifications, and equivalents of the parts and their formation and arrangement as come within the purview of the appended claims.

What is claimed is:

1. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: an essentially horizontally disposed conveyor; means for depositing continuously a uniform blanket of a mobile solid material on said con-

veyor for free fall discharge from one end of said conveyor; a fluid-jetting structure extending transversely across the path of said mobile material as it falls from said conveyor whereby the material falls around and below said fluid-jetting structure, said fluid-jetting structure having a discharge aperture at its underside for directing a gas-liquid mixture downwardly into the falling material so as to intermix therewith; a pair of propelling belts having confronting but spaced vertical reaches disposed below said fluid-jetting structure; and means for driving said belt reaches in a downward direction thereby to receive, guide, propel, and further intermix said mobile material and gas-liquid mixture.

2. An apparatus as set forth in claim 1, wherein: a screen is interposed above said fluid-jetting structure, the screen structure having apertures to permit substantially unimpeded passage of said mobile material but restrain objects of substantially greater size, said screen being inclined, and means being provided to vibrate said screen thereby to deflect said objects laterally from the path of fall of said mobile material.

3. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: an essentially horizontally disposed conveyor; means for depositing continuously a uniform blanket of a mobile solid material on said conveyor for free fall discharge from one end of said conveyor; a pair of upper and a pair of lower rollers; a pair of propelling belts having vertical confronting but spaced reaches extending between said rollers; means for driving at least one pair of said rollers to cause the upper portions of said belts to move toward each other as they pass over said upper rollers and downwardly through their confronting reaches; a collector funnel overlying the upper portions of said belts, said funnel and belts being disposed in the path of fall of said mobile material whereby said material is directed between and propelled downwardly by said belt reaches; and means interposed in said funnel for jetting a gas-liquid mixture downwardly into said mobile material to intermix therewith as it passes between said belt reaches.

4. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: propelling means defining a vertical passageway having parallel downwardly traveling side walls; a jetting structure defining a jetting slit directed downwardly midway between said side walls, said slit having a minor dimension perpendicular to said walls and a major dimension parallel to and substantially the width of said walls, and flow control means within said jetting structure for causing uniform vertically downward discharge throughout the width of said jetting slit; means for introducing a gas-liquid mixture into said jetting structure for discharge from said slit between said walls; and means for feeding mobile solid material downwardly past said jetting structure into said passageway for entrainment and intermixture with said gas-liquid mixture.

5. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: propelling means defining a vertical passageway having parallel downwardly traveling side walls; a jetting structure defining a jetting slit directed downwardly midway between said side walls, said slit having a minor dimension perpendicular to said walls and a major dimension parallel to and substantially the width of said walls, and flow control means within said jetting structure for causing uniform vertically downward discharge throughout the width of said jetting slit; means for introducing a gas-liquid mixture into said jetting structure for discharge from said slit between said walls; a conveyor for mobile solid material having a discharge end above said jetting structure; means for feeding a uniform blanket of mobile solid material onto said conveyor for free fall therefrom around and past said jetting structure into said passageway for intermixture with said gas-liquid mixture and discharge therewith from said propelling means.

6. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: propelling means defining a vertical passageway having parallel downwardly traveling side walls; a jetting structure defining a jetting slit directed downwardly midway between said side walls, said slit having a minor dimension perpendicular to said walls and a major dimension parallel to and substantially the width of said walls, and flow control means within said jetting structure for causing uniform vertically downward discharge throughout the width of said jetting slit; means for introducing a gas-liquid mixture into said jetting structure for discharge from said slit between said walls; a funnel surrounding said jetting structure and having an open end directed into said vertical passageway; and means for feeding mobile solid material into said funnel for flow around and under said jetting structure into the path of gas-liquid mixture and into said vertical passageway whereby said mobile material and gas-liquid mixture are intermixed and propelled by said walls from said propelling means.

7. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: propelling means defining a vertical passageway having parallel downwardly traveling side walls; a jetting structure including a manifold having a horizontally disposed tapered bore and a row of upwardly directed lateral ports, the larger end of said bore forming an inlet end adapted to receive a gas-liquid mixture, the sum of the areas of said lateral ports being approximately equal to the area of said inlet end whereby the flow of said mixture is substantially equally distributed to said lateral ports, a jacket surrounding said manifold and defining therewith complementary semi-cylindrical passageways, having an outlet opening diametrically opposed to said ports, and means defining a downwardly directed nozzle slit communicating with said outlet opening and having a major dimension coextensive with said row of lateral ports, and a minor dimension such that the area of said nozzle slit approximates the combined areas of said ports, whereby said mixture is uniformly distributed throughout said nozzle slit and tends to flow in parallel paths therefrom; the major dimension of said nozzle slit being substantially equal to the width of the moving walls of said propelling means to cause uniform downward flow of said gas-liquid mixture therebetween; and means for feeding mobile solid material downwardly past said jetting structure into said passageway for entrainment and intermixture with said gas-liquid mixture.

8. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: propelling means defining a vertical passageway having parallel downwardly traveling side walls; a jetting structure including a manifold having a horizontally disposed tapered bore and a row of upwardly directed lateral ports, the larger end of said bore forming an inlet end adapted to receive a gas-liquid mixture, the sum of the areas of said lateral ports being approximately equal to the area of said inlet end whereby the flow of said mixture is substantially equally distributed to said lateral ports, a jacket surrounding said manifold and defining therewith complementary semi-cylindrical passageways, having an outlet opening diametrically opposed to said ports, and means defining a downwardly directed nozzle slit communicating with said outlet opening and having a major dimension coextensive with said row of lateral ports, and a minor dimension such that the area of said nozzle slit approximates the combined areas of said ports, whereby said mixture is uniformly distributed throughout said nozzle slit and tends to flow in parallel paths therefrom; the major dimension of said nozzle slit being substantially equal to the width of the moving walls of said propelling means to cause uniform downward flow of said gas-liquid mixture therebetween; a conveyor for mobile solid material having a discharge end above said jetting structure; and means for feeding a uniform blanket of mobile solid material onto said conveyor for free fall therefrom for flow around and

past said jetting structure into said passageway for intermixture with said gas-liquid mixture and discharge therewith from said propelling means.

9. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: propelling means defining a vertical passageway having parallel downwardly traveling side walls; a jetting structure including a manifold having a horizontally disposed tapered bore and a row of upwardly directed lateral ports, the larger end of said bore forming an inlet end adapted to receive a gas-liquid mixture, the sum of the areas of said lateral ports being approximately equal to the area of said inlet end whereby the flow of said mixture is substantially equally distributed to said lateral ports, a jacket surrounding said manifold and defining therewith complementary semi-cylindrical passageways, having an outlet opening diametrically opposed to said ports, and means defining a downwardly directed nozzle slit communicating with said outlet opening and having a major dimension coextensive with said row of lateral ports, and a minor dimension such that the area of said nozzle slit approximates the combined areas of said ports, whereby said mixture is uniformly distributed throughout said nozzle slit and tends to flow in parallel paths therefrom; the major dimension of said nozzle slit being substantially equal to the width of the moving walls of said propelling means to cause uniform downward flow of said gas-liquid mixture therebetween; a funnel surrounding said jetting structure and having an open end directed into said vertical passageway; and means for feeding mobile solid material into said funnel for flow around and under said jetting structure into the path of the gas-liquid mixture and into said vertical passageway whereby said mobile material and gas-liquid mixture are intermixed and propelled by said walls from said propelling means.

10. An apparatus for applying mobile and adherent mixtures to a surface, comprising: propelling means for defining a passageway having travelling side walls, and having an entrance end and a discharge end; means for introducing a coherent interconnected mass of fibrous material into the entrance end of said propelling means; and means for also introducing a jet of a gas-liquid mixture into the entrance end of said propelling means at sufficient velocity to shred said fibrous material and intermix therewith whereby said intermixed fibrous material and gas-liquid mixture is discharged from said propelling means at high velocity.

11. An apparatus for applying mobile and adherent mixtures to a surface, comprising: a pair of propelling belts having confronting but spaced reaches defining therebetween a propelling passageway having an entrance end and a discharge end; means for driving said belts including rollers at the inlet end of said passageway around which said belts are wrapped for movement toward each other prior to forming their confronting reaches; means for applying a coherent interconnected mass of fibrous material onto each of said wrapped portions whereby said material is carried thereby into the entrance end of said passageway; and means for also introducing a jet of a gas-liquid mixture into the entrance end of said propelling means at sufficient velocity to shred said fibrous material and intermix therewith whereby said intermixed fibrous material and gas-liquid mixture is discharged from said propelling means at high velocity.

12. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: an essentially horizontally disposed conveyor; means for depositing continuously a uniform blanket of a mobile solid material on said conveyor for free fall discharge from one end of said conveyor; a pair of upper and a pair of lower rollers; a pair of propelling belts having vertical confronting but spaced reaches extending between said rollers; means for driving at least one pair of said rollers to cause the upper portions of said belts to move toward each other as they pass over said upper rollers and downwardly through their confronting reaches; a collector funnel overlying the upper portions of said belts, said funnel and belts being disposed in the path of fall of said mobile material whereby said material is directed between and propelled downwardly by said belt reaches; and means for introducing coherent webs of interlocked fibrous material between the upper end of each propelling belt and said collector funnel for movement with said propelling belts into the space between said confronting reaches, thereby to subject said fibrous material to said mobile material and jet of gas-liquid mixture whereby said fibrous material is shredded from said mass and intermixed with said mobile material and gas-liquid mixture discharged from said propelling belts.

13. An apparatus for applying mobile solid-liquid mixtures to surfaces, comprising: propelling means defining a vertical passageway having parallel downwardly traveling side walls; a jetting structure defining a jetting slit directed downwardly midway between said side walls, said slit having a minor dimension perpendicular to said walls and a major dimension parallel to and substantially the width of said walls, and flow control means within said jetting structure for causing uniform vertically downward discharge throughout the width of said jetting slit; means for introducing a gas-liquid mixture into said jetting structure for discharge from said slit between said walls; and means for introducing fibrous material into said passageway for entrainment and intermixture with said gas-liquid mixture and mobile material.

References Cited in the file of this patent

UNITED STATES PATENTS

690,505	Wurster	Jan. 7, 1902
773,479	Cornell	Oct. 25, 1904
1,881,345	Beatty et al.	Oct. 4, 1932
2,276,485	Harshberger	Mar. 17, 1942
2,370,408	MacDonald	Feb. 27, 1945
2,563,457	Dolbey	Aug. 7, 1951
2,674,545	Philips	Apr. 6, 1954
2,696,353	Vessels	Dec. 7, 1954
2,795,406	Vessels	June 11, 1957
2,809,866	Vessels	Oct. 15, 1957
2,870,039	McReynolds	Jan. 20, 1959
2,981,308	Thompson	Apr. 25, 1961